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**Certification Of Training And
Training Outcomes**

**Daron Acemoglu
Jörn-Steffen Pischke**

No. 99-28

October 1999

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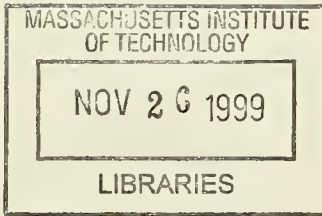
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Certification of Training and Training Outcomes

Daron Acemoglu and Jörn-Steffen Pischke
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Abstract

External certification of workplace skills obtained through on-the-job training is widespread in many countries. This may indicate that training is financed by workers, and certification serves to assure the quality of the training offered by the firm. However, other evidence shows that general training is financed by firms, especially in Germany. We show in this paper that external certification of training may also be necessary for an equilibrium with firm-sponsored training. Firm financing of training is only possible if firms have monopsony power over the workers after training. If the training firm can extract too much of the employment rents, however, workers may not have sufficient incentives to put forth effort during training. Certification increases the value training to the outside market, and hence to workers, making firm-sponsored training possible.

1 Introduction

Standard theory of human capital as developed by Becker maintains that workers should pay for investments in general skills. It makes sense that such skills are often certified by independent bodies, especially when the skills are provided by firms at the workplace. However, various pieces of evidence suggest that in a variety of circumstances firms rather than workers pay for investments in the general training of their employees (see, for example, Bishop, 1997, Acemoglu and Pischke, 1999a). Many economists have suggested that this may be because other employers do not observe whether an employee has received training with his current employer (Katz and Ziderman, 1990, Chang and Wang, 1996). According to this view, if training programs become more easily identifiable, for example due to external certification of skills, there may be less investment in training by firms. In discussing proposals for occupational certification in the U.S., Heckman, Roselius, and Smith (1994), for example, raised this issue, and argued that increased certification would discourage training.

In this light, Germany's training system is difficult to understand. Germany has an extensive apprenticeship system which most non-college-bound youths complete before becoming full-time workers. Many studies have documented that employers pay a significant part of the financial costs of these training programs (see for example the evidence presented in Acemoglu and Pischke, 1998). However, apprenticeships are highly regulated; apprentices take exams given by the chambers of commerce and crafts at the end of the training period, and receive certificates which play an important role in access to skilled jobs. The presence of certificates that make the amount and quality of the training received by a worker observable to potential employers suggests that it is not uncertainty about the quality of training that underlies firms' incentives to invest in general skills in Germany.

In Acemoglu and Pischke (1998), we developed an alternative theory of firm-sponsored training based on an asymmetry of information between current and potential employers regarding the ability of young workers. Valuable information about the abilities and aptitudes of young workers will be revealed during the early years of their career. Much of this information will be directly observed by the current employer, but not necessarily by other firms. This informational monopsony will induce firms to invest in the general skills of their employees. We argued that this theory accounts for the prevalence of the apprenticeship programs in Germany. Nevertheless, certification of training skills is puzzling for this theory as well. Why do firms operate within the regulated apprenticeship program, which they often criticize as rigid and outdated, rather than developing their

own training programs without certification?¹

In this paper, we attempt to answer this question. We discuss the role of certification of training in a labor market where some investment by the workers themselves, for example in the form of effort, is necessary during training for the successful accumulation of skills. We show that contrary to conventional wisdom, certification may actually be necessary to encourage firm-sponsored training. The institutions that certify apprenticeship skills therefore emerge as an integral part of the German training system, and their removal would not increase firm-sponsored training, but likely undermine the whole system.²

The underlying intuition for our results is simple. Firms invest in the training of their employees because they have sufficient monopsony power, which makes them, at least in part, the residual claimant for the returns to training. While labor market imperfections, and in particular asymmetric information, increase the monopsony power of firms and encourages firms to invest in training, they also reduce the workers' incentives to invest in their skills, as most of the returns will be appropriated by the firm. If effort by the worker is necessary to complete the training, the labor market arrangements have to give sufficient incentives to workers to exert this effort. If firms could observe and monitor such effort, the problem would be solved. But like most effort activities, the diligence that workers exert in training programs is hard to monitor. Alternatively, if firms could commit to reward workers *conditional on their effort*, the right incentives could be given to workers. Since the effort choice of the worker is not observed, however, this is often not possible in equilibrium either. This means that asymmetric information in the labor market might undermine the existence of training programs by not giving enough incentives to workers. In this setting, certification arises as a method of ensuring that workers receive more of the return to their general training. Certification therefore helps to balance the power between workers and firms evenly, encouraging workers to exert effort. In fact, in our simple model, firm-sponsored training arises as an equilibrium with certification, but without certification training is never an equilibrium.

We next outline the basic environment. In section 3, we characterize the equilibrium in the absence of certification. We simplify the analysis in this section by assuming that firms cannot commit to future wages, and show that in the absence of certification, there

¹Although the German firms are currently not allowed to design their training programs, this is a relatively recent development. In the past, they chose not to develop such programs, even though they could do so.

²Burtless (1994) makes an informal argument that more certification would encourage workers to obtain more training but does not clearly articulate the reasons why there is too little training without certification.

will be no training in equilibrium. In section 4 of the paper, we solve for the equilibrium with certification, and show that there now exists an equilibrium in which firms invest in the skills of their workers, and workers exert effort during the training period. In section 5, we relax the assumption of no commitment to future wages, and show that even in the presence of such commitment, certification facilitates training. In section 6, we discuss further extensions of our results.

2 The Environment

The economy consists of a large number of workers and firms. A fraction p of workers are low ability, and the remaining $1 - p$ fraction are high ability. There are two periods. At $t = 0$, no one knows a worker's ability, but at the end of the period a worker himself and his current employer learn this ability, but other firms do not. This asymmetry of information between the current employer and potential employers is the source of the monopsony power that will lead to firm-sponsored training in our economy.

Workers are not productive at $t = 0$, but they can be trained during this period. The output of a worker in period $t = 1$ is

$$y = \alpha^{e\tau} h$$

where $h = 1$ for low ability workers, and $h = \eta > 1$ for high ability workers. τ denotes whether the worker was offered training. If a worker receives no training, $\tau = 0$, otherwise $\tau = 1$. The worker also needs to exert some effort to benefit from training. We denote the effort choice of the worker by $e = 0$ or 1 where $e = 1$ has a disutility cost of c for the worker. The effort choice of the worker is his private information and cannot be contracted upon. The analysis is unaffected if effort costs differ across high and low ability workers. $\alpha - 1 > 0$ is the return to training. There is no discounting.

The cost of training is γ per worker and is incurred by the firm. We assume that workers are unable to bear this cost at $t = 0$, so all training has to be firm-sponsored.³ Moreover, since firms cannot distinguish between high and low ability workers at the beginning of $t = 0$, training has to be offered to all workers. Self-selection is also not possible because at this point workers do not know their own ability either. Finally, at the beginning of $t = 1$, workers decide whether to stay with the initial firm or not. A fraction λ of workers will quit irrespective of the wages in the outside market. The

³See Acemoglu and Pischke (1999a,b) for a discussion of possible reasons for why workers may be unable to buy training from their employers.

remaining fraction $1 - \lambda$ of workers will stay in their current job if $w \geq v$, where w is the wage offered by the current firm and v is the wage offered by the outside market.⁴

Firms in the second hand labor market never observe workers' abilities and whether they have quit or have been laid off.⁵ They may observe whether the workers receive training depending on the institutional arrangements. We distinguish between two arrangements. In the first, there is no certification of skills by independent bodies. Therefore, outside firms will not observe whether a worker has successfully completed a training program. The second institutional setup, which is similar to the German apprenticeship system, involves an outside body that runs examinations and certifies the successful completion of training programs.

The outside labor market is competitive, so wages will be such that conditional on their information, firms make zero profits.⁶ We also assume that the labor market at the beginning of time $t = 0$ is competitive, so firms may have to pay a first period training wage W to ensure zero profits. Intuitively, if the firm will make positive profits at $t = 1$ due to its ex post monopsony power, then competition at $t = 0$ will force it to pay out this profit in the form of upfront wages, W .

3 Equilibrium Without Certification

We start by showing that in the absence of certification, there will be no training. As there is no certification, all workers in the outside labor market are alike, so there will be a unique wage v . It is straightforward to see that workers will not exert training effort.

To prove this, suppose that firms offered training and workers exerted effort. In this case the outside wage would be

$$\tilde{v} = \frac{pq_l + (1 - p)q_h\eta}{pq_l + (1 - p)q_h}\alpha \quad (1)$$

where q_l is the probability that a low ability worker separates from the current firm (due to a quit or layoff) and q_h is the probability that a high ability worker separates from the firm. This equation ensures that firms in the outside market, which do not observe worker ability or training, make zero profits in expectation. Since worker training is not observed, a worker who deviates and chooses not to exert effort will get utility equal to $W + \tilde{v}$ (first period wage, W , and outside wage, $\tilde{v}$). Also notice that the maximum wage

⁴This is the formulation of the asymmetric information model used in Acemoglu and Pischke (1999b).

⁵A distinction that is vacuous in this simple model anyway, since the firm can always set wages so as to induce all low ability workers to quit.

⁶Formally, we are looking for a Perfect Bayesian Equilibrium of this game. See Acemoglu and Pischke (1998).

that the current firm will pay in the second period is $w = \tilde{v}$, the outside wage at the time; if the firm paid a higher wage, it would not retain any more workers, so would necessarily make less profits. This implies that the return to a worker exerting effort is at most $W + \tilde{v} - c$, which is strictly less than the utility from not exerting any effort, $W + \tilde{v}$. This implies that without certification workers will not exert effort, and so there will be no training.

Intuitively, firms are unable to reward workers for exerting effort; outside firms cannot distinguish trained and untrained workers, so all workers will earn the same wage in the outside market. This in turn means that the training firm will also pay a single wage to both trained and untrained workers. It could promise ex-ante to pay a higher wage to trained workers, but such a promise would not be credible. Absent a possibility for committing to this higher wage, the firm would always benefit in the second period from reneging on this promise. We assume such a commitment is not possible here but return to this issue in section 5 below. Also notice that there is no role for training firms to engage in certification of training themselves. Since the firm benefits from paying a lower wage, it has an incentive not to certify any workers as trained.

Equilibrium is now straightforward to characterize. Employers at $t = 1$ offer $w(h = \eta) = v$ to their high ability employees, and at most $w(h = 1) = 1$ to low ability workers.⁷ Since a fraction λ of high ability workers quit, outside wages v will be greater than 1, and therefore all low ability workers will indeed quit. Outside wages are

$$v = \frac{p + (1 - p) \lambda \eta}{p + (1 - p) \lambda} > 1.$$

Firms make second period profits of $\Pi_0 = (1 - \lambda)(1 - p)(\eta - v) \equiv \Pi$ where the last equality defines Π , which is a term that will reoccur throughout the paper. To ensure zero profits in period $t = 0$, firms will pay upfront wages $W = \Pi$.

4 Equilibrium with Certification

Now consider the same economy with an outside body certifying successful completion of training. In this case outside firms do not observe ability, but they observe whether the worker has successfully completed training. Notice that certification implies that the firm has offered training and the worker has exerted effort. There will be two different outside wages now, one v_n for workers without certified training, the other v_t for a worker with a

⁷When offering a wage $w(h = 1) = 1$ firms realize that workers will quit. We therefore refer to this strategy as a “layoff”.

certificate of training. With the same reasoning as above we have

$$v_t = \frac{pq_l^t + (1-p)q_h^t\eta}{pq_l^t + (1-p)q_h^t}\alpha \text{ and } v_n = \frac{pq_l^n + (1-p)q_h^n\eta}{pq_l^n + (1-p)q_h^n} \quad (2)$$

where q_l^n is the probability that a low ability worker who does not have training (either because the firm did not offer it or because he did not exert effort) has separated from the firm. The other q 's are defined similarly.

Now consider an allocation (a candidate equilibrium) in which firms offer training to all their workers, and all workers exert effort. Specifically, the firm offers a wage of $w_t = v_t$ to all workers who are high ability and have exerted effort, and lays off all other workers. In this case, the outside wage for workers with the certificate (who are necessarily trained) will be

$$v_t = \frac{p + (1-p)\lambda\eta}{p + (1-p)\lambda}\alpha. \quad (3)$$

The wages for workers who have not exerted any effort are going to be the same as in the no certification case. A worker who has not exerted effort and turns out to be low ability produces 1. Since some high ability workers will be in the outside market again, the outside wage is $v_n > 1$, so the initial firm will not retain any low ability workers. The firm may want to keep high ability workers without training, by offering them $w_n = v_n$, if the productivity of these workers η is greater than v_n . It is straightforward to see that $\eta > v_n$ will always be the case, so the outside wage is

$$v_n = \frac{p + (1-p)\lambda\eta}{p + (1-p)\lambda} = v, \quad (4)$$

and a firm keeps some of the high ability workers who have not exerted effort. The fraction of high and low ability workers in the outside market are still the population fractions and do not depend on behavior because workers make their effort decision before knowing their type. This implies $v_t = \alpha v_n$.

Next, we can determine whether workers prefer to exert effort during training. They will do so if $v_t > v_n + c$. Substituting from (3) and (4), we find that this inequality is equivalent to

$$(\alpha - 1) \frac{(1-p)\lambda\eta + p}{(1-p)\lambda + p} > c, \quad (5)$$

that is, the return to training should be sufficiently high, especially as compared to the cost of effort, c . We assume this condition holds in the rest of the analysis. The presence

of training certificates now ensures that the outside market rewards the workers according to their skills, hence effort, ensuring the correct incentives.

Is it now also profitable for firms to offer training? Consider the profits of a firm that offers training in this equilibrium,

$$\Pi_t = (1 - \lambda)(1 - p)(\alpha\eta - v_t) - \gamma = \alpha\Pi - \gamma,$$

where Π was defined above. In contrast, if it chooses not to train, its profits are

$$\Pi_n = (1 - \lambda)(1 - p)(\eta - v_n) = \Pi$$

Firms will prefer to invest in the training of their employees if $\Pi_t > \Pi_n$ or if

$$\begin{aligned} (\alpha - 1)(1 - \lambda)(1 - p)(\eta - v_n) &> \gamma \\ (\alpha - 1)\Pi &> \gamma \end{aligned} \tag{6}$$

If α and η are sufficiently large and γ is sufficiently small, this condition will be satisfied, and so, with certification of training, there will exist an equilibrium with firm-sponsored training. As before, $t = 0$ wages adjust to ensure zero profits, hence $W_t = \alpha\Pi - \gamma$.

The main result of this section is therefore that, as long as conditions (5) and (6) hold, there will be an equilibrium with training when the training results are externally certified, but no training in the absence of certification. Given conditions (5) and (6), welfare will be higher in the equilibrium with certification and training. To see this, add (5) and (6) to obtain

$$\begin{aligned} (\alpha - 1)(v + \Pi) &> \gamma + c \\ \Rightarrow W_t + \alpha v_t - c &> W + v \end{aligned} \tag{7}$$

where we have exploited the fact that $W = \Pi$, $W_t = \alpha\Pi - \gamma$, and $\alpha > 1$. The left hand side of the second line of (7) is the utility of a worker in a training equilibrium, while the right hand side is the utility in a no training equilibrium. Since firms make zero profits, (7) establishes that welfare in the training equilibrium is greater. Certification is therefore welfare enhancing.

5 Training with Wage Commitments

Our analysis above was simplified by the assumption that firms set the post-training wages at time $t = 1$, ruling out commitments to wages. Although this may be a reasonable assumption for many firms, for large German companies, it might be more plausible to

assume that they can use their reputation to commit to a wage path.⁸ It is important to investigate the role of this assumption since in the presence of such commitments, training may be an equilibrium even without certification. Intuitively, our analysis in section 3 exploited the fact that the maximum wage the firm will pay at $t = 1$ is $w = v$, so the worker had nothing to gain by exerting effort as he could get the outside wage v even without exerting effort.

The alternative is a situation in which the firm commits to a higher wage in period $t = 1$, say w_c , and encourages workers to exert effort. There is an important constraint, however. Because we do not have certification, worker effort is not verifiable, and therefore contracts cannot be contingent on a worker's effort choice. This implies that w_c has to be high enough so that the expectation of getting this higher wage encourages workers to exert effort. Only high ability workers will receive w_c while low ability workers will still be laid off and receive v . Workers do not know their ability when they have to make their effort choice, so they will base their decision on the expected gain from exerting effort. Since low ability workers will be laid off and a fraction λ of high ability workers will quit voluntarily, the maximum expected gain from exerting effort is $(1 - p)(1 - \lambda)(w_c - v)$, which needs to be at least as great as c . We will also assume that the firm can commit to lay off high ability workers, who have not exerted effort, even when it is not in the short run interest of the firm.⁹

Suppose the firm commits to a wage for retained workers sufficient to encourage effort. This implies that all workers exert effort, hence

$$v = v_t = \frac{p + (1 - p)\lambda\eta}{p + (1 - p)\lambda}\alpha$$

Therefore, we need

$$w_c = \frac{c}{(1 - p)(1 - \lambda)} + v_t$$

Without certification, the firm will only follow the training strategy if profits from training

$$\Pi_{ct} = (1 - \lambda)(1 - p)(\alpha\eta - w_c) - \gamma$$

⁸More formally, we could imagine a repeated game similar to our static economy where firms are infinitely lived, but workers live only two periods. If workers can observe the past wage offers of firms, there could exist a self-sustaining equilibrium where firms would be punished if they renege on their wage promises. To keep the exposition simple, we do not discuss this more complicated model in this paper.

⁹In a repeated game framework, if the firm were to retain a worker who has not exerted effort, then all workers in the future would prefer not to exert effort. Therefore, retaining such workers is incompatible with a wage commitment strategy.

are larger than the profits Π from not training workers. Thus, even with the possibility of commitment but no certification, there exists a set of parameter values, defined by $\Pi_{ct} < \Pi$, which ensures that it is unprofitable for firms to provide training and encourage worker effort. This condition together with (6) implies

$$\gamma < (\alpha - 1)\Pi < c + \gamma. \quad (8)$$

When (5) and (8) are both satisfied, firms will provide training only when there is outside certification.¹⁰ Thus, wage commitments do not necessarily ensure equilibrium firm-sponsored training without certification, and certification institutions may still be necessary for high investments in training.

6 Concluding Remarks

We have kept the model above deliberately simple to clearly illustrate the main point of our analysis: external certification of training may be necessary to provide sufficient incentives for workers to contribute their part to training investments and ensure that firms invest in worker training. Many of the assumptions are very special but not essential to the qualitative results. It is useful at this point to discuss briefly a few of the key ones.

The assumption that workers do not know their type ex-ante, while relatively implausible in this strict form, is not crucial. Our basic results still hold if workers perfectly knew their type ex-ante. In the case with commitment, however, low ability workers will not choose to exert effort anymore, since they do not get a payoff from it. More important, the firm will be able to induce high ability workers to exert effort with a lower wage commitment. The range of parameters where wage commitments can ensure firm-sponsored training will therefore be larger. In the case of Germany, however, where workers enter apprenticeships at a relatively young age, like 15 or 16, it is unlikely that they have very good knowledge about all their own aptitudes and comparative advantages.

We have also assumed that certification allows perfect discrimination between workers who have exerted effort during training and those who have not. In practice, effort and ability may be substitutes in examinations, so that more able workers may be able to obtain the training certificate with less effort than low ability workers. This makes

¹⁰In fact, the condition for commitment to ensure training is more stringent than the one given in the text. Equilibrium commitment requires the discounted present value of a profit stream, Π_{ct}/r , to be greater than the alternative, where r is the discount rate. The firm will receive a larger profit now from reneging on the promised wage w_c to trained workers now. It will pay them v_t instead, saving the wage premium, but also receive only profits Π from then on. This means commitment requires $\Pi_{ct} \geq \Pi + rc$. This condition boils down to the one in the text when $r \rightarrow 0$.

putting in no effort more attractive for workers in the certification case, and therefore leads to a more stringent condition than (5).

In Acemoglu and Pischke (1998), we show that the adverse selection model becomes more interesting when the decision of workers to quit voluntarily at the beginning of period $t = 1$ is not completely exogenous. Instead, we model the quit decision as depending on the relative inside and outside wages, i.e. a fraction $1 - F(w - v)$ of workers quits, where F is a probability distribution function. We show that in this setup multiple equilibria are possible. One equilibrium may be characterized by few quits, low outside wages, and lots of training, while another equilibrium exhibits a high quit rate, a high outside wage and little or no training. It is similarly possible to obtain multiple equilibria in the certification case. This implies that introducing certification in an economy without such credentials and no training may not necessarily lead to a high training equilibrium. If, for example, the initial turnover rate of the economy is too high, training may not arise in this particular economy, even though it could be sustained as an equilibrium. This highlights that certification is only one institutional feature which helps support training in an economy like Germany.

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